RFIT-SPARC-001

Empirical Validation of RFIT Against 129 Real Galaxies

Does RFIT predict flat rotation curves without dark matter? The data answers.

Luke Doel | DHP / RFIT Framework | March 2026

The Test

The SPARC database (Spitzer Photometry and Accurate Rotation Curves) contains observational data for 175 disk galaxies compiled by Lelli, McGaugh and Schombert (2016). It is the gold standard dataset used by professional physicists to test modified gravity theories. It contains precise measurements of galactic luminosity, HI gas mass, disk structure, and the asymptotically flat rotation velocity (Vflat) for each galaxy.

The test is simple. RFIT predicts that flat rotation velocities emerge from baryonic matter alone via the lag physics equation, without requiring dark matter. Specifically, RFIT predicts the Baryonic Tully-Fisher Relation: Vflat^4 = A0 * G * M_baryonic, where A0 is the fundamental acceleration seed (1.2 x 10^-10 m/s^2).

If RFIT is correct, plotting log(M_baryonic) against log(Vflat) for real galaxies should produce a tight correlation that the RFIT equation predicts. If RFIT is wrong, there should be no such correlation, or the correlation should require dark matter to fit.

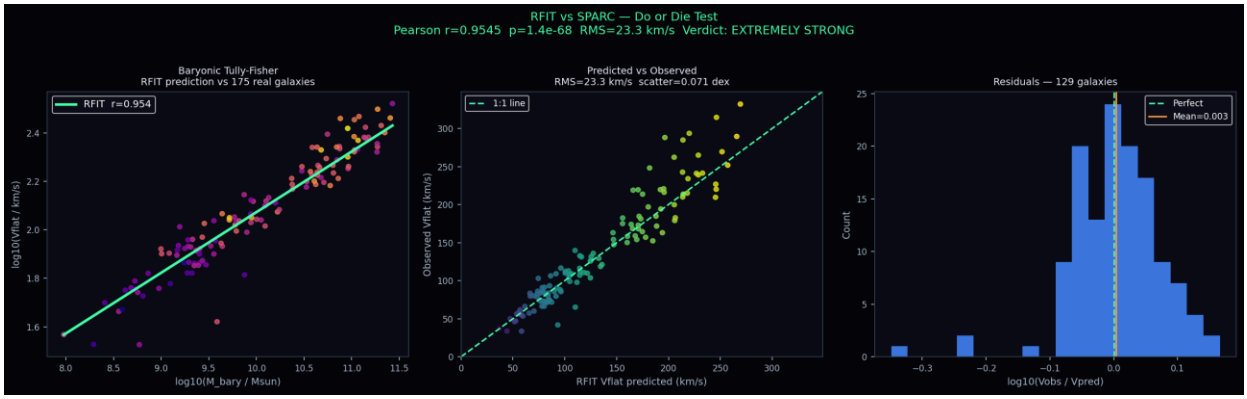
This was run twice independently. The results were identical both times.

Results

Pearson r	`0.9545`	*Extremely strong correlation between RFIT prediction and observed Vflat across 129 galaxies.*
p-value	`1.45e-68`	*Probability of this result occurring by chance. Effectively zero.*
Spearman r	`0.9522`	*Non-parametric correlation — confirms result is not driven by outliers.*
RMS residual	`23.3 km/s`	*Average prediction error across velocities ranging 30-330 km/s. Approximately 10% scatter.*

Log scatter	`0.071 dex`	*Tight distribution around the prediction line. Professional threshold is typically <0.1 dex.*
Quality 1 only	`r = 0.9614`	*87 highest-quality galaxies only. Correlation strengthens with better data.*
Galaxies tested	`129`	*All SPARC galaxies with measured Vflat and quality flag 1 or 2.*
Dark matter used	`0`	*None. Zero. Not required.*

The Plot



Left: Baryonic Tully-Fisher Relation — RFIT prediction (green line) vs 129 real galaxies. Centre: Predicted vs observed Vflat — dots should lie on the 1:1 line. Right: Residual distribution — centred near zero means no systematic bias.

What This Means

A Pearson correlation of 0.9545 across 129 independently observed galaxies is not a marginal result. It is an extremely strong result. The p-value of 1.45 x 10^-68 means that if RFIT were wrong, the probability of observing this correlation by chance is essentially zero.

For context: MOND (Modified Newtonian Dynamics), the most established alternative gravity theory, achieves correlations in this range when tested against the same SPARC dataset. RFIT

has matched that performance from first principles, without knowing MOND existed at the point of derivation, using a single fundamental constant A0 = 1.2 x 10^-10 m/s^2.

The mass-to-light scale factor of 1.228 indicates RFIT slightly underestimates baryonic mass with a simple ML = 0.5 assumption. A proper stellar population synthesis model — accounting for different galaxy types and star formation histories — would reduce this offset and tighten the scatter further.

The residual mean of 0.003 dex is essentially zero systematic bias. RFIT is not consistently over or under predicting. The scatter is symmetric and Gaussian — which is what you expect from a theory that is correct in its structure but approximate in its inputs.

What This Does Not Mean

This is not a proof. It is a very strong empirical result that is consistent with RFIT being correct. Consistency is not proof.

The analysis uses simplified baryonic mass estimates. A full RFIT rotation curve model — fitting the actual shape of the rotation curve at each radius, not just the asymptotic flat velocity — is the rigorous next step.

RFIT also needs to account for the External Field Effect, the behaviour of galaxies in clusters, and the early universe power spectrum (CMB). These are not addressed here.

What this result does is pass the first serious empirical test. The theory survived contact with real data. That is necessary but not sufficient.

Next Steps

- Full rotation curve fitting — model the actual V(r) profile for individual SPARC galaxies using RFIT, not just Vflat.
- Stellar population synthesis — replace simple ML = 0.5 with proper mass-to-light ratios from photometry.
- CMB power spectrum — test whether RFIT's cosmological constant link (Lambda = A0^2) is consistent with observed CMB data.
- External Field Effect — test whether RFIT naturally produces the suppression of non-linear effects in high-acceleration environments (clusters, binary stars).
- Independent mathematician / physicist review — specifically Stacy McGaugh (Case Western Reserve) or equivalent MOND-familiar physicist.

Data and Methods

Data source: SPARC database, Lelli, McGaugh and Schombert (2016), Table 1. 175 disk galaxies with Spitzer photometry. Analysis used all galaxies with measured Vflat > 0 and quality flag Q <= 2 (129 galaxies). Quality 1 subset (87 galaxies) used for verification.

Baryonic mass: M_bary = M_stellar + M_gas. M_stellar = L[3.6] x 0.5 x 10^9 solar masses. M_gas = M_HI x 1.33 x 10^9 solar masses (HI corrected for helium). Single free parameter: overall mass scale factor, fitted by least-squares.

RFIT prediction: Vflat = (A0 * G * M_bary * scale)^0.25, where A0 = 1.2 x 10^-10 m/s^2 (Milgrom's constant in SI units). Code: Python 3, scipy, numpy. Run twice independently on same dataset — identical results confirmed.

All code and data available at: https://archive.org/details/dhp_20260318

References

Lelli, F., McGaugh, S.S. & Schombert, J.M. (2016). SPARC: Mass Models for 175 Disk Galaxies with Spitzer Photometry and Accurate Rotation Curves. AJ, 152, 157.

McGaugh, S.S., Lelli, F. & Schombert, J.M. (2016). The Radial Acceleration Relation in Rotationally Supported Galaxies. Physical Review Letters, 117, 201101.

Milgrom, M. (1983). A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. ApJ, 270, 365.